INDOOR AIR QUALITY ASSESSMENT

John J. Duggan Middle School
1015 Wilbraham Road
Springfield, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program

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Background/Introduction

At the request of Principal Maritza Valentine, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA), provided assistance and consultation regarding indoor air quality concerns at the John J. Duggan Middle School (DMS), 1015 Wilbraham Road, Springfield, Massachusetts. The request was prompted by occupant complaints of headaches, breathing difficulties, skin irritation and exacerbation of allergies and asthma.

A visit to conduct an indoor air quality assessment was made on May 2, 2003 by Michael Feeney, Director of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA. Cory Holmes, an Environmental Analyst in the ER/IAQ Program, Judy Dean, American Lung Association of Western Massachusetts and Charles Casio, School Custodian, accompanied Mr. Feeney during the assessment.

The DMS is a two-story brick building constructed in the late 1950's. The school is built into a hill with portions of the ground floor subterranean. Locker rooms, the gymnasium, shops, the kitchen, cafeteria and general classrooms are located on the ground floor. The first floor contains science classrooms, general classrooms, office space and an auditorium. The second floor is made up of general classrooms. Windows are openable throughout the building.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

The DMS has a student population of approximately 900 and a staff of approximately 120. Tests were taken during normal operations at the school and results appear in Table 1.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were below 800 parts per million of air (ppm) in forty-three of sixty-one areas surveyed, indicating adequate ventilation in most areas of the school. It is also important to note, that a number of classrooms had open windows during the assessment, which can greatly reduce carbon dioxide levels.

Fresh air in classrooms is supplied by a unit ventilator (univent) system (Picture 1). Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building (Picture 2) and return air through an air intake located at the base of each unit (Figure 1). Fresh and return air are mixed, filtered, heated and provided to classrooms through an air diffuser located in the top of the unit. Univents were found deactivated in classrooms throughout the school. Obstructions to airflow on and in front of univent returns were seen in a number of classrooms (Picture 3). In order for univents to provide fresh air as designed, these units must remain activated and allowed to operate while these rooms are occupied. Air diffusers and return vents must also remain free of obstructions.

Exhaust ventilation in classrooms is provided by ducted, grated wall vents (Picture 4) powered by rooftop motors. At the time of the assessment a number of exhaust vents were not operating or operating weakly, indicating that motors were deactivated or non-functional. In addition, a number of the vents were blocked by desks, bookcases, and shelving. In some cases, open classroom doors blocked exhaust vents (Picture 5). In such cases, exhaust efficiency can be limited by the location of exhaust vents. When a classroom door is open, exhaust vents will tend to draw air from both the hallway and the classroom. The open hallway door reduces the effectiveness of the exhaust vent to remove common environmental pollutants from classrooms. As with the univents, in order to function properly, exhaust vents must be activated and remain free of obstructions. Without removal by exhaust ventilation, normally occurring environmental pollutants can build up and lead to indoor air complaints.

Fresh air in the gymnasiums, locker rooms and the auditorium is provided by ceiling-mounted air handling units (AHUs). These AHUs were not operating during the assessment and appeared not to have been in operation for some time. The woodshop also contains a dedicated AHU. The unit was operating at the time of assessment.

The speech/pathology room was created through the construction of walls to divide classroom 112. The speech/pathology room has no means of mechanical ventilation or openable windows.

Of note was a grated hole found in the floor of classroom 1 (Picture 6). The purpose of this vent was not readily discernable by BEHA staff. No draw of air was noted, however, it is possible that the hole serves as an exhaust vent. The vent/hole could use the crawlspace beneath the floor of this wing as a duct. If the mechanical ventilation system this vent belongs to was deactivated, drafts, particulates and odors from beneath the floor can migrate into this classroom.

In order to have proper ventilation with a mechanical supply and exhaust system, these systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last balancing of these systems was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix A.

Temperature readings were measured in a range of 70^{o} F to 79^{o} F, which were very close to the BEHA comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. A number of temperature control/comfort complaints were expressed throughout the building. It is difficult to control temperature and maintain comfort without operating the ventilation equipment as designed (e.g. univents deactivated, exhaust vents obstructed/inoperable). In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in the building ranged from 45 to 61 percent, which was also very close to the BEHA recommended comfort range. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. Humidity is more difficult to control during the winter heating season. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

The building has a history of roof leaks. Active leaks were reported in the ground floor hallway outside of the cafeteria and in classroom 211. A number of areas had water-damaged ceiling tiles and plaster (Pictures 7 and 8). Water-damaged ceiling tiles and other porous building materials can provide a medium for mold growth and should be replaced after a water leak is discovered and repaired.

The girls' locker room has a shower that is not used (Picture 9). There does not appear to be local exhaust ventilation for the shower. Water damage and mold growth was observed on the ceiling above the shower. Located in the ceiling of the shower stall is an insulated ventilation duct. The insulated duct is connected to the aforementioned AHU and provides ventilation to locker room. Since the shower has no apparent local exhaust ventilation, use of the shower would result in the duct insulation becoming chronically moistened by water vapor. Use of this shower would perpetuate mold growth.

Exterior window and frame caulking was crumbling/damaged in a number of areas, indicating that the water seal is no longer intact (Picture 10). Water damaged plaster was noted around the interior of windows with corresponding exterior caulking damage (Picture 11). The damage is most likely attributable to water penetration around window frames during rainstorms. Replacement of caulking and repairs of window leaks are necessary to prevent water penetration. Repeated water damage can result in mold colonization of porous building materials, curtains and/or items stored on or around windowsills.

Plants and potting soil were located in many rooms, and several of the plants were on top of classroom univents and in close proximity to univent air intakes along the perimeter of the building (Pictures 12 and 13). Plant soil and drip pans can serve as a source of mold growth. Plants should be located away from the air stream of univents to prevent entrainment and aerosolization of dirt, pollen or mold. Several plants were noted in standing water (Picture 14). Stagnant water can be a source for bacterial/mold growth and unpleasant odors.

Signs of bird roosting and nesting were observed in a number of recesses (e.g., overhangs, broken block windows) around the exterior of the building (Pictures 15a and 15b). No obvious signs of bird roosting inside the building or in ventilation components were noted by BEHA staff or reported by occupants. Birds can be a source of disease, and bird wastes and feathers can contain mold and mildew, which can be irritating to the respiratory system.

Certain molds are associated with bird waste and are of concern for immune-compromised individuals. Other diseases of the respiratory tract may also result from chronic exposure to bird waste. Exposure to bird wastes is thought to be associated with the development of hypersensitivity pneumonitis in some individuals. Psittacosis (bird fancier's disease) is another condition closely associated with exposure to bird wastes in either the occupational or bird rearing setting. While immune-compromised individuals have an increased risk of health impacts following exposure to the materials in bird wastes, these impacts may also occur in healthy individuals exposed to these materials.

The methods employed for cleaning of a bird waste problem depend on the amount of waste and the types of materials contaminated. The MDPH has been involved in several indoor air investigations where bird waste has accumulated within ventilation ductwork (MDPH, 1999). Accumulation of bird wastes have required the clean up of such buildings by a professional cleaning contractor. In less severe cases, the cleaning of the contaminated material with a solution of sodium hypochlorite has been an effective disinfectant (CDC, 1998). Disinfection of non-porous materials can be readily accomplished with this material. Porous materials contaminated with bird waste should be examined by a professional restoration contractor to determine whether the material is salvageable. Where a porous material has been colonized with mold, it is recommended that the material be discarded (ACGIH, 1989).

The protection of both the cleaner and other occupants present in the building must be considered as part of the overall remedial plan. Where cleaning solutions are to be used, the “cleaner” is required to be trained in the use of personal protective methods and equipment to prevent either the spread of disease from the bird wastes and/or exposure to cleaning chemicals. In addition, the method used to clean up bird waste may result in the aerosolization of particulates that can spread to occupied areas via openings (doors, etc.) or the ventilation system. Methods to prevent the spread of bird waste particulates to occupied areas or into ventilation ducts must be employed. Given that containment procedures warranted are similar to those used to contain the spread of renovation-generated dusts and odors in occupied areas, the cleaner should employ the methods listed in the SMACNA Guidelines for Containment of Renovation in Occupied Buildings (SMACNA, 1995). A copy of an issue of the Centers for Disease Control Morbidity and Mortality Weekly Report for July 10, 1998, which covers the clinic aspects as well as clean up associated with bird waste, is included as Appendix B.

Other Concerns

Several other conditions that can potentially affect indoor air quality were identified. Although no complaints of vehicle exhaust odors have been reported within the building, the potential for entrainment exists. Picture 16 shows a bus parked with the exhaust near an air intake. Picture 17 illustrates the close proximity of the employee parking lot to the building and the potential for vehicle exhaust to be drawn, or entrained, into the univent fresh air intakes. Idling vehicles produce vehicle exhaust that may become entrained in the ventilation system and become distributed in building; this may, in turn, provide opportunities for exposure to compounds such as carbon monoxide. M.G.L. chapter 90 section 16A prohibits the unnecessary operation of the engine of a motor vehicle for a foreseeable time in excess of five minutes (MGL, 1996).

Fuel odors were reported in classroom 18, which is located adjacent to the maintenance garage. A pair of double doors connects classroom 18 to the garage (Picture 18). Large spaces were observed around the double doors, allowing odors from fuel containers and other maintenance equipment (e.g., lawn mowers/snow blowers) to migrate into the classroom.

Of note is the location of the garage doors, which are located within a sheltered bay on the west wall of the school. Wind direction in New England is predominantly westerly (Trewartha, 1943). The erection of a sheltered bay facing west will tend to prevent wind from moving around the west wall, which then increases air pressure on the garage doors. The increased air pressure on the exterior door forces cold outdoor air into the garage through seams and holes in the outer door (Picture 19). Cold air then pressurizes the garage interior, subsequently forcing air through spaces around the doors/frames into adjacent areas such as classroom 18 (Pictures 18 and 19). Under these conditions, odors and pollutants generated from materials stored in the garage and operation of vehicles and gasoline-powered equipment can migrate into areas adjacent to the garage.

A number of univents had accumulated dirt, dust and debris within the air handling chambers (Picture 20). These conditions can be attributed to non-continuous univent use, allowing airborne particulates to settle within the units. In addition, AHUs that have been deactivated for prolonged periods of time (e.g., the locker rooms/ gymnasium units) can also have an accumulation of dust and debris. In order to prevent equipment from serving as a source for aerosolized particulates, the air handling sections of the univents and AHUs should be regularly cleaned (e.g., during regular filter changes).

Similarly, exhaust vents in several classrooms and restrooms had accumulated dust. If exhaust vents are not functioning, backdrafting can occur, causing reaerosolization of dust particles. In addition, these particulates can accumulate on flat surfaces in occupied areas and, subsequently, be re-aerosolized causing further irritation.

Portable air purifiers were located in several areas. This equipment is normally equipped with filters, which should be cleaned or changed as per the manufacturer's instructions to avoid the build up and re-aerosolization of dirt, dust and particulate matter.

Also of note was the amount of materials stored inside classrooms. In classrooms throughout the school, items were observed on windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate and make it difficult for custodial staff to clean. Dust can be irritating to eyes, nose and respiratory tract. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up.

Teachers' lounges contained a number of photocopiers. Of note is that at least one printer (e.g., Risograph®) uses a liquid toner. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). The teachers' lounge is not equipped with local exhaust ventilation.

Accumulated chalk dust and dry erase board particulate were noted in several classrooms. Chalk dust and dry erase board particulates can be easily aerosolized and serve as eye and respiratory irritants. In addition, materials such as dry erase markers and dry erase board cleaners may contain VOCs (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can also be irritating to the eyes, nose and throat.

Several rooms had missing and/or dislodged ceiling tiles. Missing/dislodged ceiling tiles can provide a pathway for the movement of drafts, dusts and particulate matter between rooms and floors.

A strong chemical odor was detected in the hallway outside of classrooms 3 through 5. Fire doors in this hallway separate these classrooms from the other hallways on the first floor. The hallway does not appear to have any means for mechanical ventilation, and natural ventilation is limited when the fire doors are closed. The source of this odor appeared to be two plug-in type air fresheners observed in room 4A. Room 4A does not have mechanical exhaust ventilation. Operation of the fresh air supply pressurizes the room and forces the fragrance out to the hallway. Lack of exhaust ventilation results in the accumulation of the fragrance in this hallway, between the fire doors. Air fresheners contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Furthermore, air fresheners do not remove materials causing odors, but rather mask odors that may be present in the area.

Strong urine odors were noted in several restrooms. Mechanical exhaust ventilation in a number of restrooms was not functioning during the assessment. Exhaust ventilation is necessary in restrooms to remove moisture and to prevent odors from penetrating into adjacent areas.

DMS staff reported that showers in locker rooms are rarely used. Drain traps are designed to form a water seal to prevent the backup of sewer odors. Without frequent input of water, the airtight seal on the trap can be breached. A broken water seal results in a sewer gas back up in the drainage. Odors can then enter occupied areas. Sewer gas can create nuisance odors and be irritating to certain individuals.

Excessive amounts of wood dust on flat surfaces were noted in the woodshop. BEHA staff also noted a significant amount of wood dust in the wood shop general return vent, which indicates that sawdust is aerosolized from machinery and is entrained by the ventilation system. Wood dust can be irritating to the eyes, nose, throat and respiratory system. As previously mentioned, the wood shop contains a dedicated AHU. Within the AHU are heating elements. Wood dust can become entrained in the AHU. Under certain conditions, wood dust collecting in the AHU can become a fire hazard.

Conclusions/Recommendations

The conditions noted at the DMS raise a number of indoor air quality issues. The combination of the general building conditions, maintenance, design and the operation (or lack of operation) of HVAC equipment, if considered individually, present conditions that could degrade indoor air quality. When combined, these conditions can serve to further negatively affect indoor air quality. Some of these conditions can be remedied by actions of building occupants. Other remediation efforts will require alteration to the building structure and equipment. For these reasons, a two-phase approach is recommended. Recommendations consist of **short-term** measures to improve air quality and **long-term** measures requiring planning and resources to adequately address the overall indoor air quality concerns.

The following **short-term** measures should be considered for implementation:

1. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers throughout the school.
2. Operate ventilation systems that are operable continuously during periods of school occupancy, independent of thermostat control, throughout the building (e.g., gym, auditorium, classrooms).
3. Inspect exhaust motors and belts for proper function. Repair and replace as necessary.
4. Reactivate exhaust ventilation in restrooms to remove odors and moisture.

5. Remove all blockages from univents and exhaust vents to ensure adequate airflow. Keep classroom doors shut to avoid blockage of exhaust vents.
6. Consult a ventilation engineer concerning re-balancing of the ventilation systems. Ventilation industrial standards recommend that mechanical ventilation systems be balanced every five years (SMACNA, 1994).
7. Examine the feasibility of providing mechanical ventilation to classroom 112A. If not feasible install passive vents in doors to provide air exchange.
8. Ascertain the function of the grill shown in Picture 5A. If it is an exhaust vent, restore the means to provide air movement. If it is not part of the ventilation system, consider sealing this grille.
9. Examine the feasibility of providing exhaust ventilation for room 4A.
10. Remove birds' nests from exterior of building and install bird screens as needed. To prevent possible exposure to bird wastes, implement the corrective actions recommended concerning remediation of bird wastes as described Appendix B. To prevent possible spread of bird waste particulates to occupied areas, employ the methods listed in the SMACNA guidelines for Containment of Renovation in Occupied Buildings (SMACNA, 1995).
11. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

12. Isolate and repair water leaks. Repair/replace any water-damaged ceiling tiles, plaster and/or other damaged building materials. Examine above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial. Building occupants should report any roof leaks or other signs of water penetration to school maintenance staff for remediation.
13. Relocate plants away from univents in classrooms. Avoid over-watering and examine drip pans periodically for mold growth. Disinfect with an appropriate antimicrobial where necessary. Consider reducing the number of plants.
14. Remove and replace water damaged insulation from the duct in the girls' locker room. Disable the showerhead and seal the floor drain to prevent further water damage to insulation. Operate the locker room ventilation system when the locker room and gymnasium office are occupied.
15. Seal unused shower drains or pour water down regularly to prevent dry traps and associated odors.
16. Remove plant growths against the exterior wall/foundation of the building to prevent water penetration. Trim trees in rear of building away from brickwork.
17. Replace missing ceiling tiles to prevent the egress of dirt, dust and particulate matter into classrooms.
18. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
19. Clean chalkboards and dry erase board trays regularly to avoid the build-up of particulates.

20. Consider replacing maintenance garage doors (leading to classroom 18) or seal around doors with weather-stripping material to prevent the egress of odors.

21. Change filters for air-handling equipment, air purifiers and window-mounted air conditioners and as per the manufacturer's instructions or more frequently if needed. Vacuum interior of units prior to activation to prevent the aerosolization of dirt, dust and particulates. Ensure filters fit flush in their racks with no spaces in between allowing bypass of unfiltered air into the unit.

22. Clean univent return vents and exhaust vents periodically of accumulated dust.

23. Consider developing a written notification system for building occupants to report indoor air quality issues/problems. Have these concerns relayed to the maintenance department/ building management in a manner to allow for a timely remediation of the problem.

24. Consider relocating parking areas such that they are not close to the building. If not feasible, post signs instructing vehicles not to back in and to shut engines off after five minutes as required by Massachusetts General Laws 90:16A.

25. Increase cleaning of wood dust from wood shop surfaces. This can include the use of a vacuum cleaner equipped with a HEPA filter.

26. Inspect interior of woodshop AHU and ductwork for accumulated wood dust clean if necessary. Consider providing more efficient filters for woodshop return vents.

27. Refrain from using strongly scented materials (e.g., air fresheners) in classrooms.

The following **long-term measures** should be considered:

1. Consider contacting an HVAC engineer concerning repair/replacement of the HVAC system. Based on the age, physical deterioration and availability of parts of the HVAC system, the BEHA strongly recommends that an HVAC engineering firm be consulted for a full evaluation of the ventilation system for proper operation, and/or repair/replacement considerations.
2. Repair and/or replace thermostats and pneumatic controls as necessary to maintain control of thermal comfort. Consider contacting an HVAC engineer concerning the repair and calibration of thermostats and pneumatic controls school-wide.
3. Repair/replace missing or damaged window caulking building-wide to prevent water penetration through window frames. During this project it is recommended that all water-damaged materials be examined for microbial growth and structural integrity.
4. Consider installing local exhaust vents in teacher's workrooms to help reduce excess heat and odors from office equipment.

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Picture 1

Classroom Univent

Picture 2

Univent Fresh Air Intake

Picture 3

Plants and Other Items on and In Front of Univent, Obstructing Airflow

Picture 4

Classroom Exhaust Vent

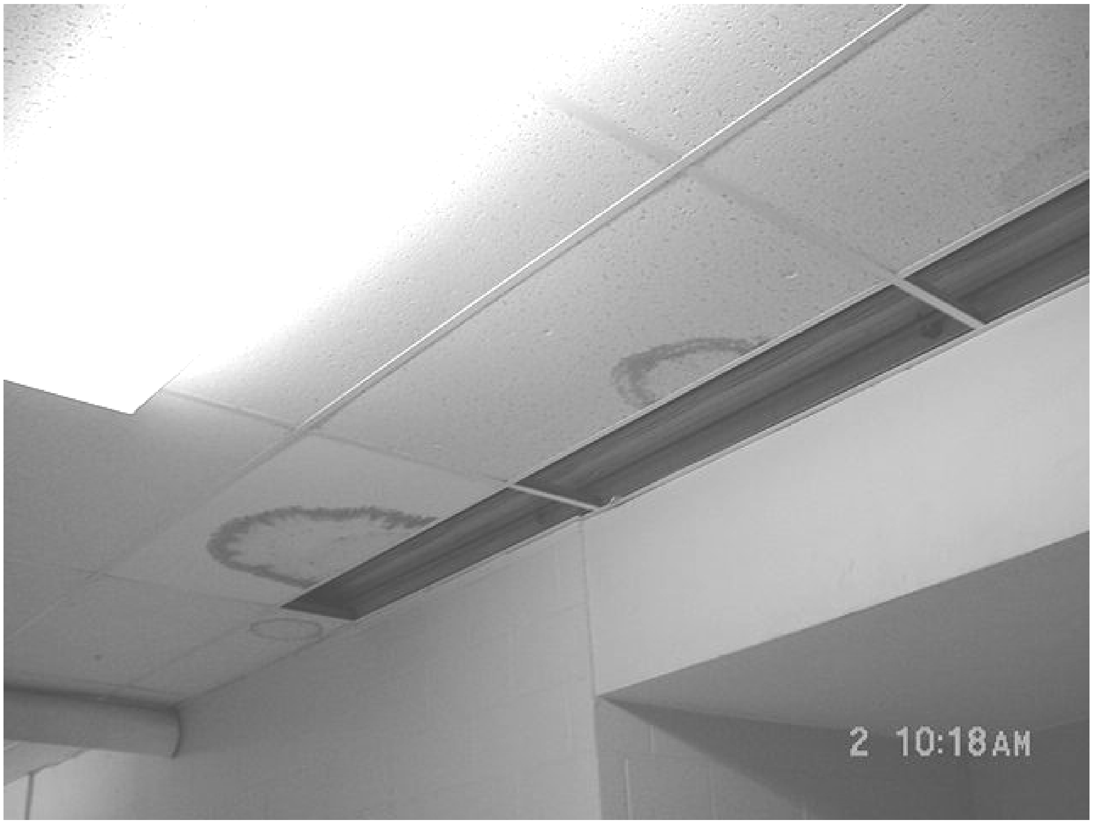
Picture 5

Classroom Exhaust Vent Obstructed by Open Hallway Door

Picture 6

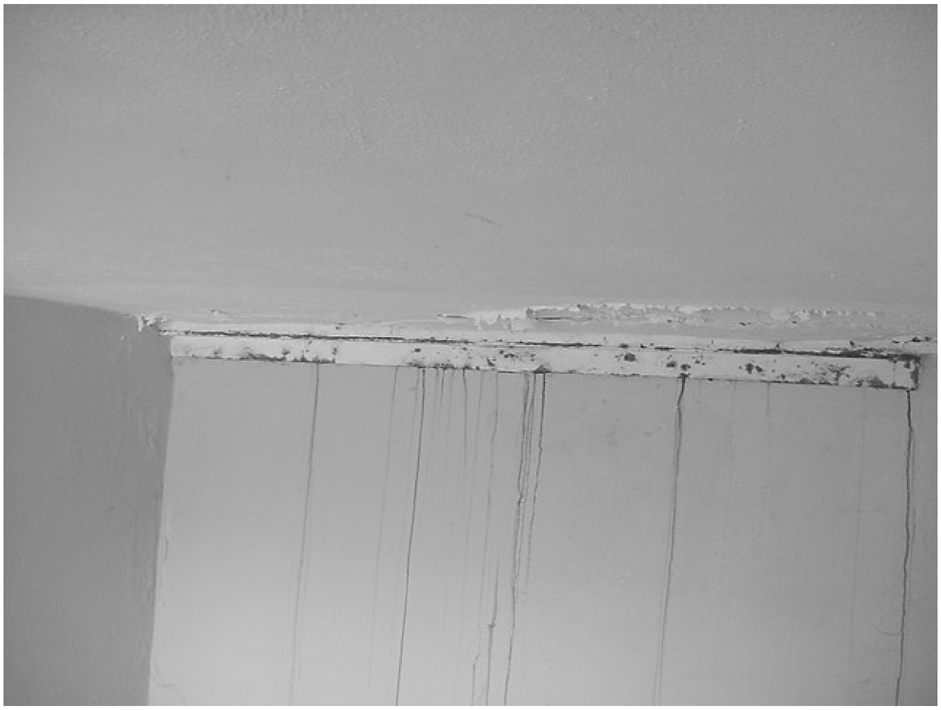
Grille in floor of classroom 1

Picture 7



Missing/Water Damaged Ceiling Tiles

Picture 8



Water Damage along Ceiling, Note Drip Lines

Picture 9

Shower Stall in Girls' Locker Room, Note Water Damaged Duct Insulation above Shower

Picture 10

Missing/Damaged Caulking around Window Frames

Picture 11

Water Damaged Wall Plaster between Window Frames

Picture 12

Plants on Top of a Classroom Univent Air Diffuser

Picture 13

Plants/Shrubbery in Close Proximity to Univent Fresh Air Intake

Picture 14

Plant in Standing Water, Jar Green with Algae/Mold Growth

Picture 15a

Birds Nests in Crevices of Walkway Overhang, Note Bird Wastes on Windows and Doors

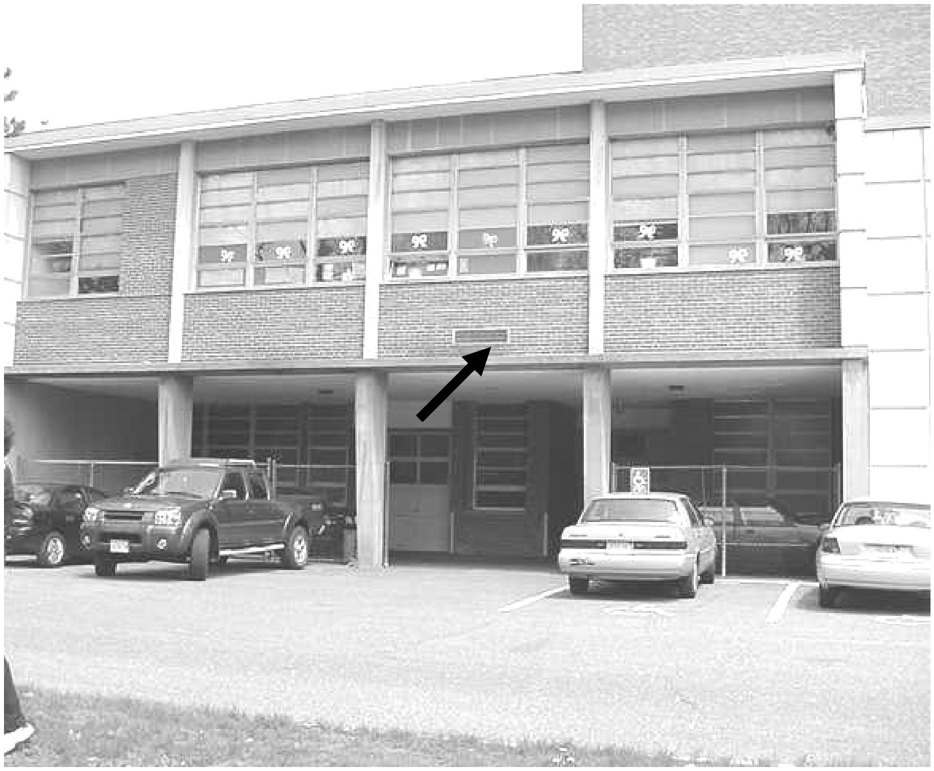
Picture 15b

Close up of Birds Nests in Crevice of Awning

Picture 16

Bus in Close Proximity to Air Intake

Picture 17



Cars Parked in Close Proximity to Classroom Univent Air Intake

Picture 18

Double Doors Connecting Classroom 18 To The Garage

Picture 19

Bottom of Garage Door, Note light penetration and torn door gasket

Picture 20

Accumulated Dirt, Dust and Debris in Univent Interior

TABLE 1

Indoor Air Test Results: Duggen Middle School, Springfield, MA   May 2, 2003

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Outside (Background)	436	69	57					Sunshine, scattered clouds NE winds 5-10 mph
Asst. Principal's Office	761	73	58	1	Y	N	N	Window open
Guidance Councelor	812	73	58	4	Y	N	N	Window open Plants in standing water
Ground Floor Hallway								Chronic leaks missing/damaged CTs
Teacher's Lounge	760	72	56	0	N	Y	N	Photocopier, no local exhaust Passive vents
Teacher's Rest Room					N	Y	Y	No draw exhaust vent Passive vents in door
Room 17	1200	73	56	11	N	Y	Y	Air purifier, door open No air flow from vent
Room 18	1351	75	52	15	Y	Y	Y	Door open, plants on paper towels, double doors to garage-spaces beneath/between door reports of fuel odors

WD = water damage
CT = ceiling tile
WB = wallboard

ppm = parts per million parts of air

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred 600 – 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 1

Indoor Air Test Results: Duggen Middle School, Springfield, MA **May 2, 2003**

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Room 6	860	75	55	24	Y	Y	Y	Window/door open, UV off, missing CT along windows, exhaust vent obstructed/off
Room 7	752	75	56	16	Y	Y	Y	Window open, chalk dust, exhaust weak draw
Room 4-B	1009	77	52	10	Y	Y	Y	Exhaust no draw, missing CT
Room 4-A	1332	77	53	0	Y	Y	Y	2 plug in air fresheners, missing/ damaged tiles, no exhaust, strong chemical odors
Room 2	1100	75	52	0	Y	Y	Y	Window/door open, chalk dust, 2 UVs, exhaust no draw
Basement Hallway								WD stains on wall
Pool	491	78	64	0	N	Y	Y	WD ceiling plaster/peeling paint
Girls Locker Room	811	78	50	2	N	Y	Y	AHU not operating, reactivated shower drains dry traps

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Auditorium	635	73	40	0	N	Y	Y	
Room 116	1221	74	50	16	Y	Y	Y	Plants in standing water, upholstered furniture, exhaust – no draw
Room 115	689	77	55	18	Y	Y	Y	Window open, exhaust – no draw, plants on UV, 7 CTs, 1 dislodged
Room 114	584	79	53	20	Y	Y	Y	Window open, 25 + plants, exhaust no draw, plants on UV
Room 113	784	78	51	15	Y	Y	Y	UV deactivated, window open
Room 113-B	743	78	52	9	Y	Y	Y	Window open, UV deactivated, exhaust vent – no draw
Room 112	586	78	49	0	Y	Y	Y	13 CT (interlocking), window open
Room 112-A					N	N	N	No ventilation, no windows

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TABLE 1

Indoor Air Test Results: Duggen Middle School, Springfield, MA — May 2, 2003

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Room 111	640	78	49	7	Y	Y	Y	Window/door open, UV deactivated, no AC, 20+ computers
110	581	76	51	28	Y	Y	Y	Window open, exhaust off, MTs
Teacher's Gentlemen	640	77	52	0	Y	N	N	Window open, photocopier (3), RR – passive vent sealed exhaust vent deactivated
Room 109	510	70	52	22	Y	Y	Y	Window open, exhaust not operating, MTs
Asst. Principal Cameron	686	75	51	0	Y	N	N	Window open
Mr. Swan	501	75	53	0	Y	N	N	Window open
Room 206	550	76	54	20	Y	Y	Y	Window open, UV not operating, exhaust vent obstructed
Room 204	701	78	55	23	Y	Y	Y	Window/door open, 15 CT, plants

WD = water damage
CT = ceiling tile
WB = wallboard

ppm = parts per million parts of air

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 – 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

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Indoor Air Test Results: Duggen Middle School, Springfield, MA **May 2, 2003**

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Room 207	636	79	53	25	Y	Y	Y	Window open, UV not operating, exhaust vent no draw, 6 CT
Room 203	602	78	53	20	Y	Y	Y	Window/door open, exhaust no draw, 2 dislodged CT, UV not operating, temperature complaints
Room 202	543	78	51	0	Y	Y	Y	Window open exhaust blocked by book case, UV not operating
Room 201	556	72	50	2	Y	Y	Y	Window/door open, 5 CT, chalk dust, exhaust vent blocked by file cabinet
Supply Room 217	544	77	48	1	N	Y	N	Photocopier, passive vent, 1 door
Room 212	565	77	51	14	Y	Y	Y	Items on 1 front of UV – not operating, exhaust vent no draw, 5 CT
Room 213	515	77	52	10	Y	Y	Y	Window/door open, items on UV
Room 214	555	77	52	24	Y	Y	Y	Window open, UV not operating 1 broken CT

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						Supply	Exhaust	
Room 210	665	78	52	28	Y	Y	Y	Window/door open, 3 plants, exhaust vent in ceiling
Room 211	709	79	51	27	Y	Y		Window/door open, items (plants) in front of UV – not operating, active leaks reported along windows/ceiling, no mechanical exhaust vent
Perimeter Notes								M/D outside window caulking, birds nesting in walkway overhang, plants along building
Girls Locker Office	651	78	47	2	Y	N	N	Shower – no vent, WD insulation duct, door open
Room 103	1268	76	54	31	Y	Y		WD, door open
Room 104	548	76	52	10	Y	Y	Y	Window open, 4 CT
Room 107	857	76	54	27	Y	Y	Y	Window open, supply off, exhaust blocked with file cabinet

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						Supply	Exhaust	
Room 105	883	78	55	22	Y	Y	Y	Window/door open, exhasut blocked with file cabinet
Library	1009	79	51	22	Y	Y	Y	Window open, 23 computers, musty carpet
Room 100	957	78	52	22	Y	Y	Y	Window open, supply off
T Room	421	78	49	0	Y	N	N	Window/door open, 3 photocopiers
Room 107	495	77	50	0	Y	Y	Y	Window open, ants, 2 CTs
School Councelor	773	76	45	0	N	N	N	Door vent
Nurses Office	687	76	52	5	Y	Y	Y	Window/door open
Cafeteria	566	77	54	100+	Y	Y	Y	Window open
G Room	609	71	61	2	Y	N	N	Window/door open, musty carpet
Main Office	622	72	60	4	Y	N	N	Window/door open, photocopier

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						Supply	Exhaust	
Main Office Principal	487	72	59	1	Y	N	N	Window open
Room 7	726	74	57	0	Y	Y	Y	AT-6, door open
Room 10	810	72	54	18	Y	Y	Y	Exhaust off, dark room exhaust off
Room 9	620	72	56	19	Y	Y	Y	Welding fume hood off, door open
Wood Shop	572	73	57	19	Y	Y	Y	
Room 5	733	75	53	25	Y	Y	Y	Plants on vent, exhaust off
Room 3	1049	75	54	19	Y	Y	Y	Window open, exhaust off, air ioniser
Room 1	888	75	50	0	Y	Y	Y	Window/door open, exhaust off, vent in front
Gym	539	76	53	40+	N	Y	Y	Ceiling fans, door open supply and exhaust off
Room 215	415	77	52	0	Y	N	N	Window open, CT 7

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